Office of the Chief Information Officer

• The GRC OCIO enables and supports an efficient High Technology, High-Performing work environment for NASA GRC and Agency partners •

AR, VR and NUI
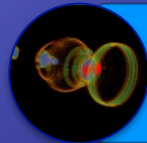# NASA Glenn Graphics and Visualization (GVIS) Lab
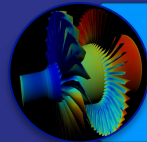
AR, VR and NUI

Benefits of visualization

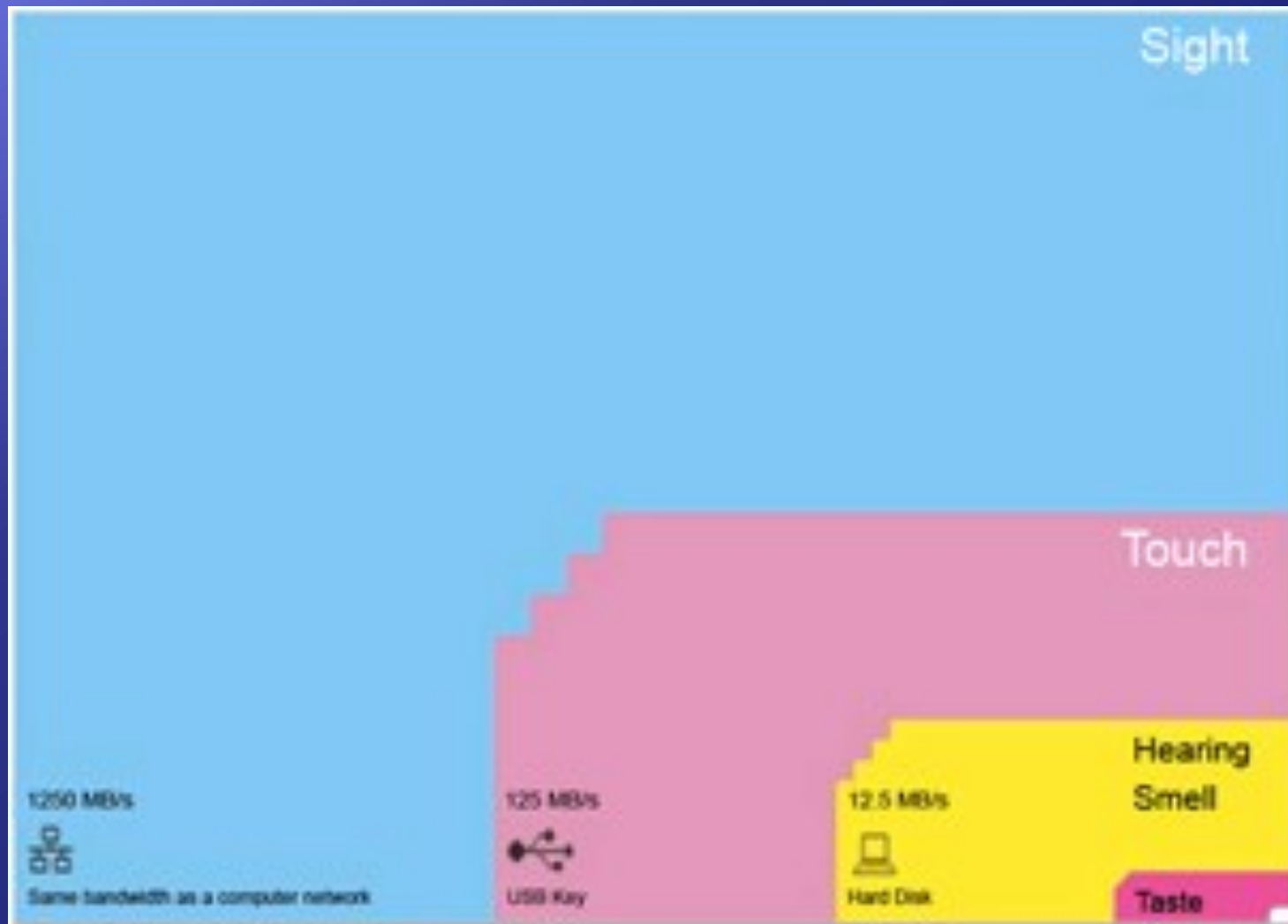Drivers and industry

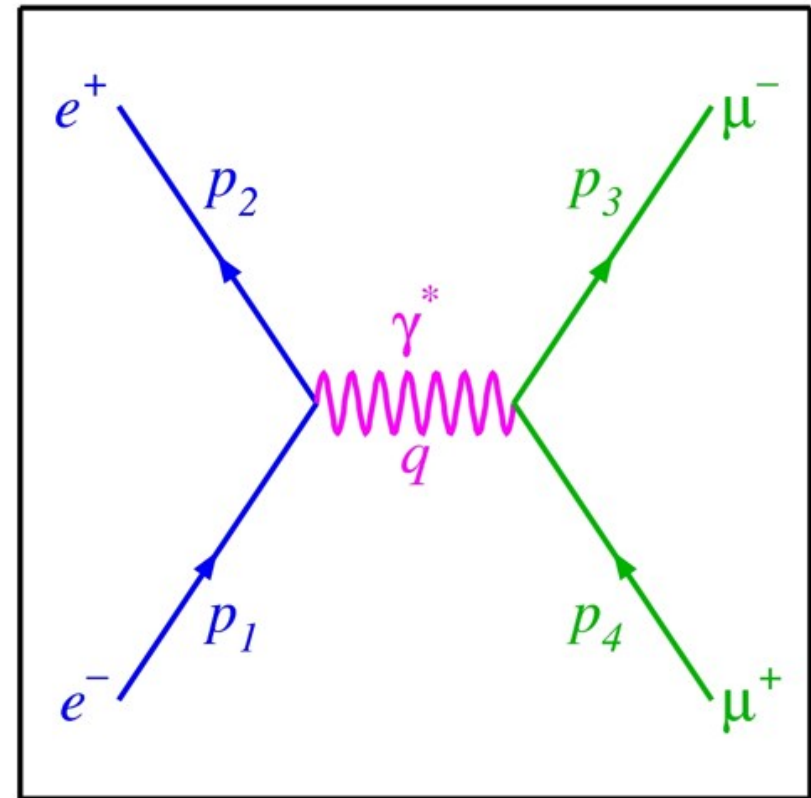Current technologies

At NASA Glenn GVIS Lab

At NASA

Demos

# Bandwidths of human senses

Infographic created by David McCandless based on data from Tor Norretranders

Visualization: key to discovery & understanding

Importance of visualization

- …thinking hard about how to learn the most from any data set should always involve some … visual statistical display
- The greatest value of a picture is when it forces us to notice what we never expected to see
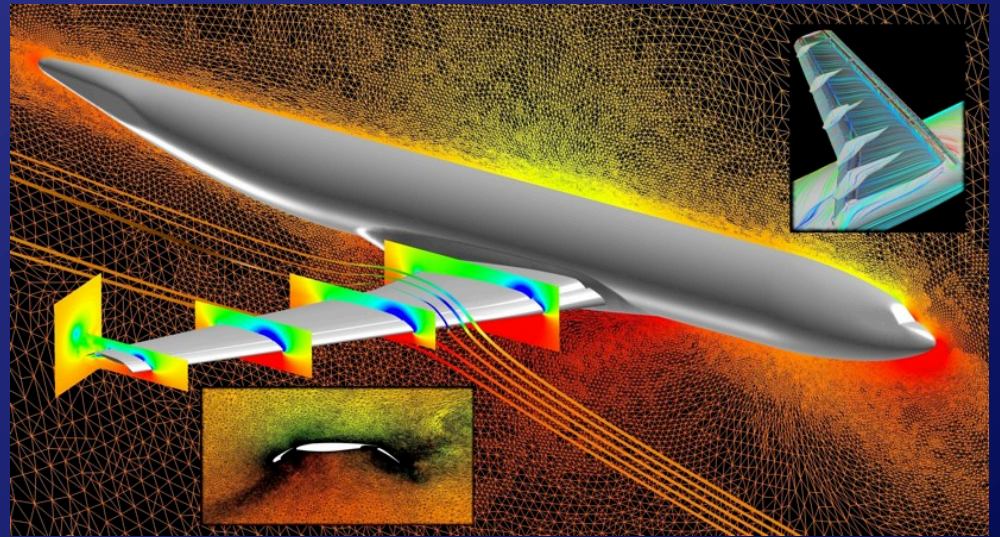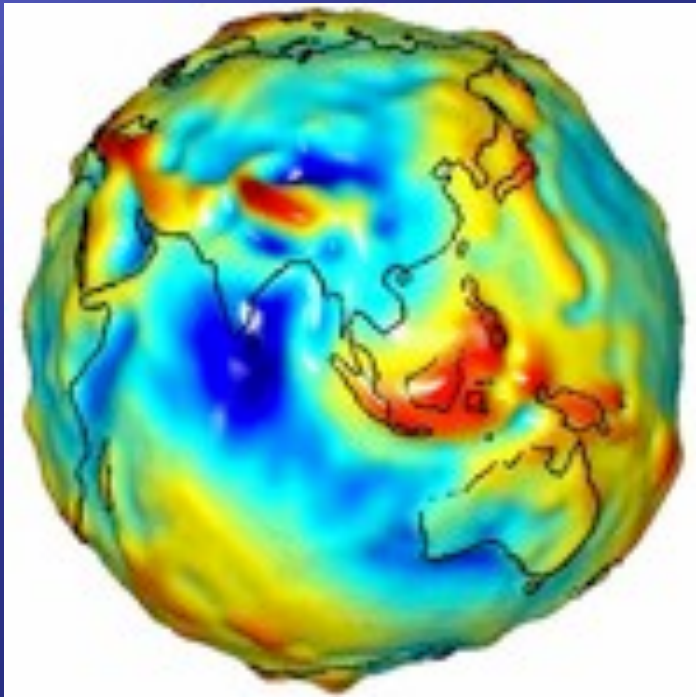
Why visualization matters

Enhance working memory

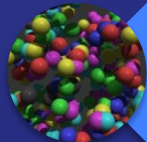Detect patterns in data
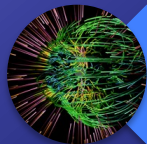
Create abstractions from data

Build things we can't build

See things we can't see

Go to places we can't go

What if you could…

Explore your results more easily and fully?
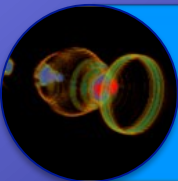
Detect patterns including potential errors in data ?

Analyze and collaborate on larger data sets ?
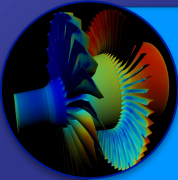
Explain your results to others in a more engaging, exciting way ?

Create models in a more natural way?

Explosion of display and interaction technologies

Central circle: **Virtual Reality / Augmented Reality / Natural User Interfaces**

Surrounding boxes: 3D Displays, Graphics Cards, Large Displays, Immersive Environments, High Res Displays, Multi-touch surfaces, Pico projectors, Mobile devices, Wearables, Head Mounted Displays, 3D Capture Devices, Tracking, 3D Printing
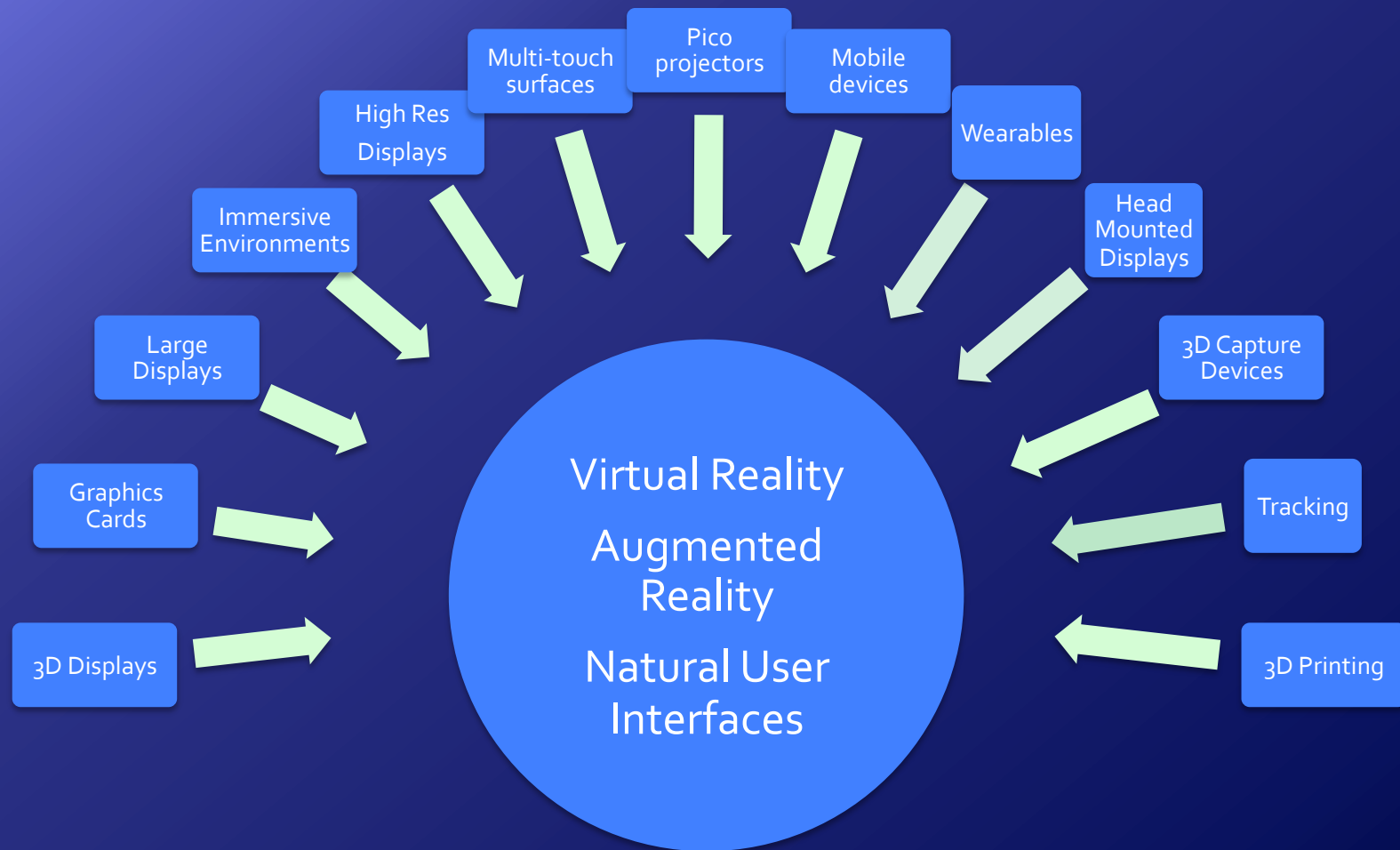
Consumer drivers
for increased AR, VR and NUI

- Science fiction
- Mobile devices
- Maker movement
- It's cool!
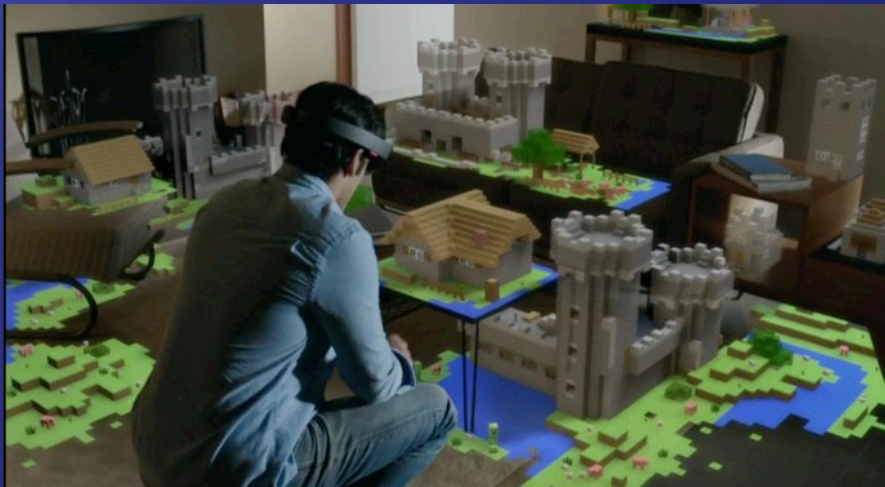
Workplace drivers
for increased AR, VR and NUI

- Remote collaboration
- Virtual prototyping
- Big data/visual analytics
- Training, education, and outreach

National Aeronautics and Space Administration

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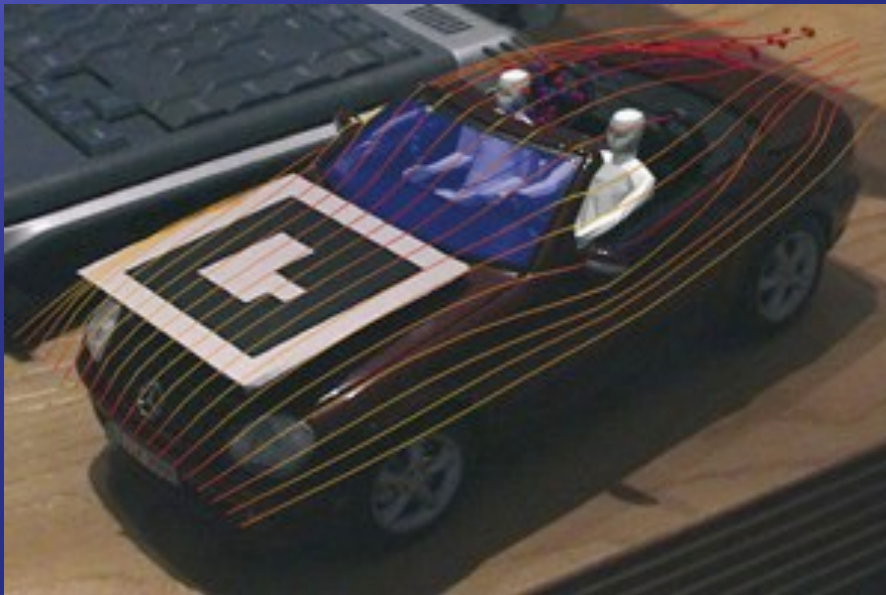
Gartner's 2015 Hype Cycle for Emerging Technologies

Natural User Interfaces (NUI)

Right now, we interact with computers in a very unnatural 2D way."

With the Leap Motion Controller, "you can really apply your intuition and take something from your mind to a physical object with far greater ease than we currently do."

— Elon Musk
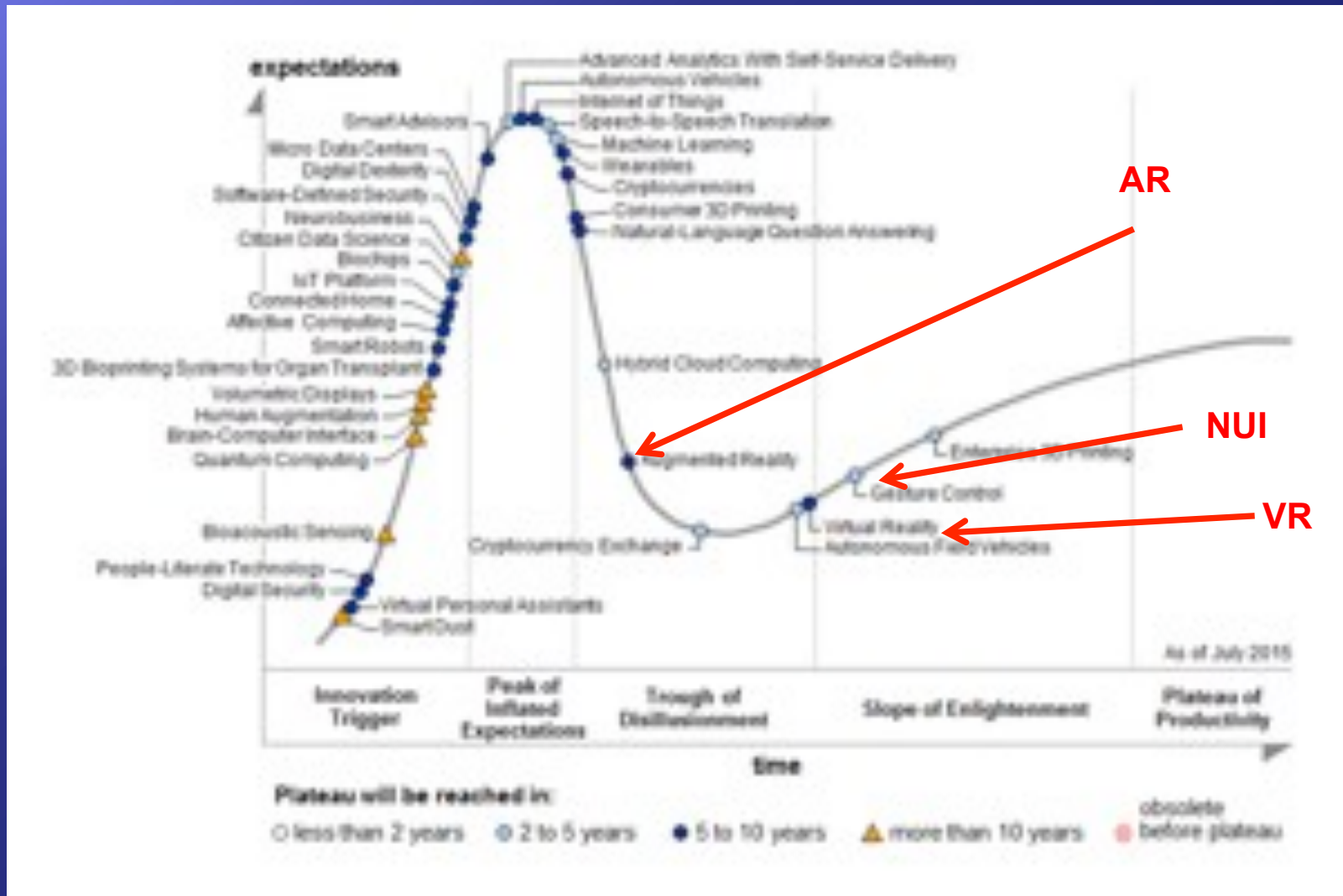
http://www.youtube.com/watch?v=xNqs_S-zEBY#t=0

Natural User Interfaces (NUI)

Similar to how we interact with real world
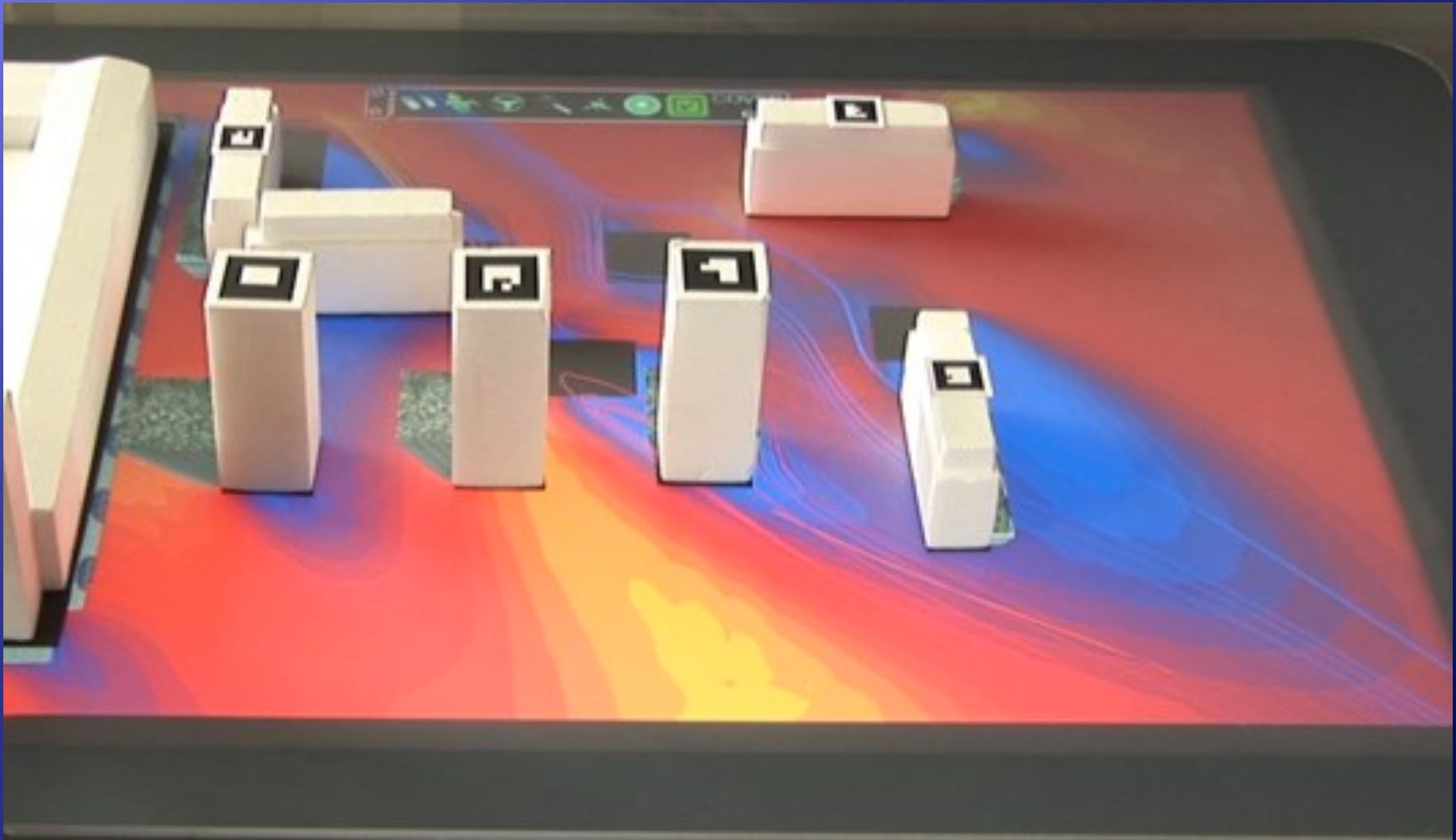
Frees brain for cognition, creativity and exploration

Should become invisible to the user

Tangible interfaces

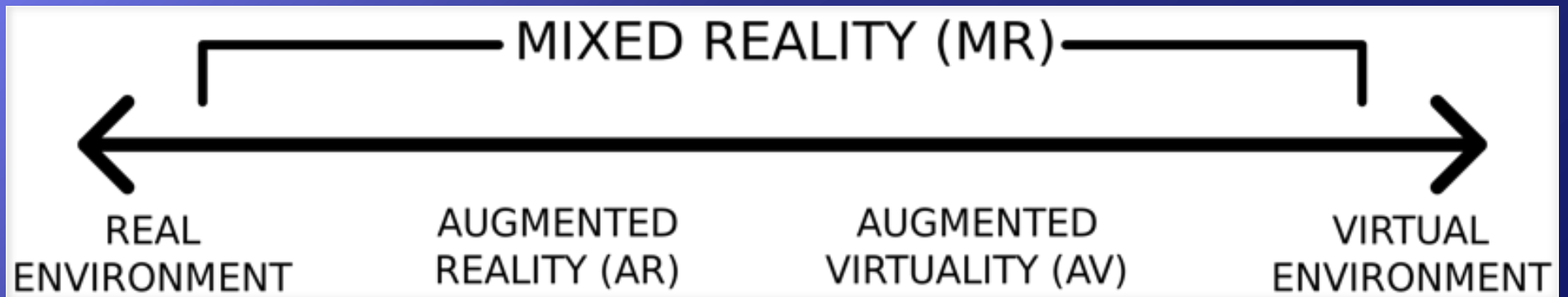## Manipulate digital information with your hands

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Latest 3D and NUI devices

zSpace

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National Aeronautics and Space Administration   Case Western Reserve University EECS500 Spring 2016 Department Colloquium– February 25, 2016   Office of the Chief Information Officer   15
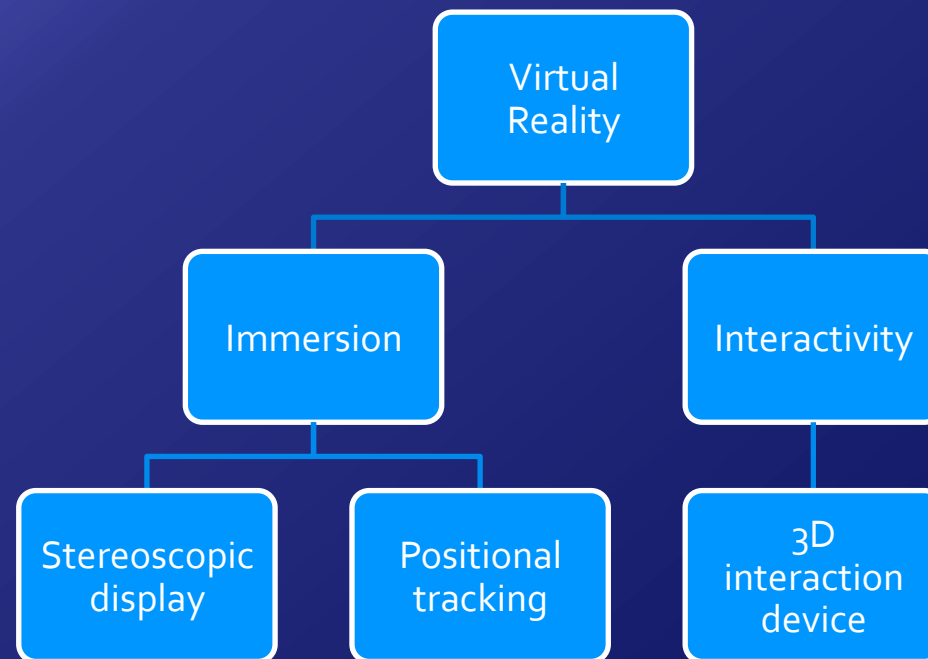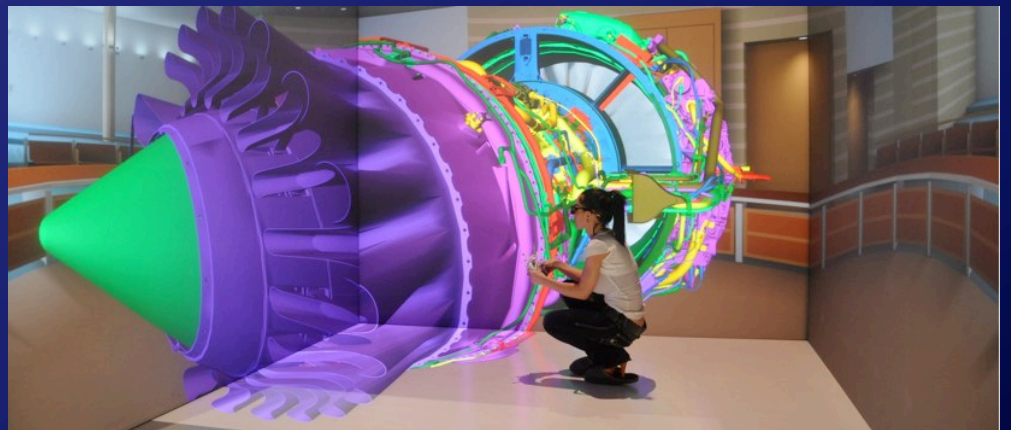
Mixed Reality (MR) continuum

What is Virtual Reality?

- Ultimate goal of virtual reality (VR) is to create a sense of "presence" that makes the virtual world seem just as real as the physical
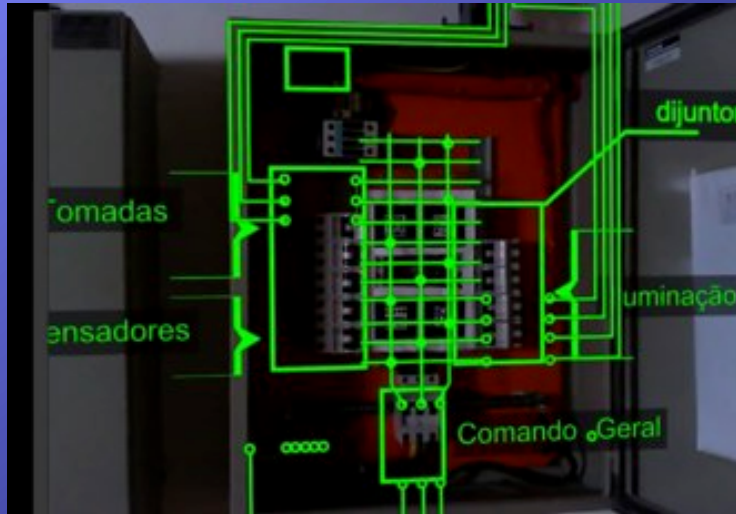
```
                    ┌──────────────┐
                    │   Virtual    │
                    │   Reality    │
                    └──────┬───────┘
              ┌────────────┴────────────┐
      ┌───────────────┐         ┌───────────────┐
      │   Immersion   │         │ Interactivity │
      └───────┬───────┘         └───────┬───────┘
        ┌─────┴──────┐                  │
  ┌───────────┐ ┌───────────┐     ┌───────────┐
  │Stereoscopic│ │ Positional│     │    3D     │
  │  display   │ │  tracking │     │interaction│
  └───────────┘ └───────────┘     │  device   │
                                  └───────────┘
```

http://www.metaio.com/

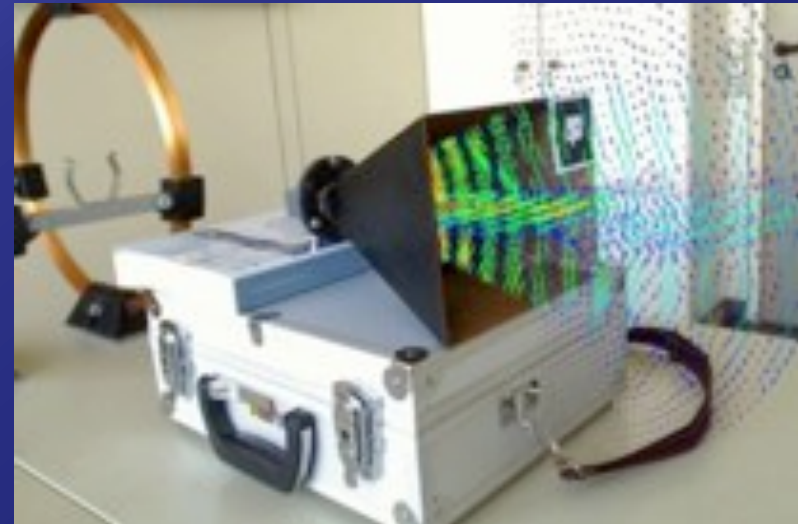# CAVE™ (Cave Automatic Virtual Environment)

Head Mounted Displays (HMDs)

Mobile device augmented reality

Electric panel

Electromagnetics

Architecture

Air flow

HMDs for augmented reality

Meta Pro

Daqri Smart Helmet

Magic Leap

Microsoft HoloLens

Projection augmented reality

Put imagery and information where you need it

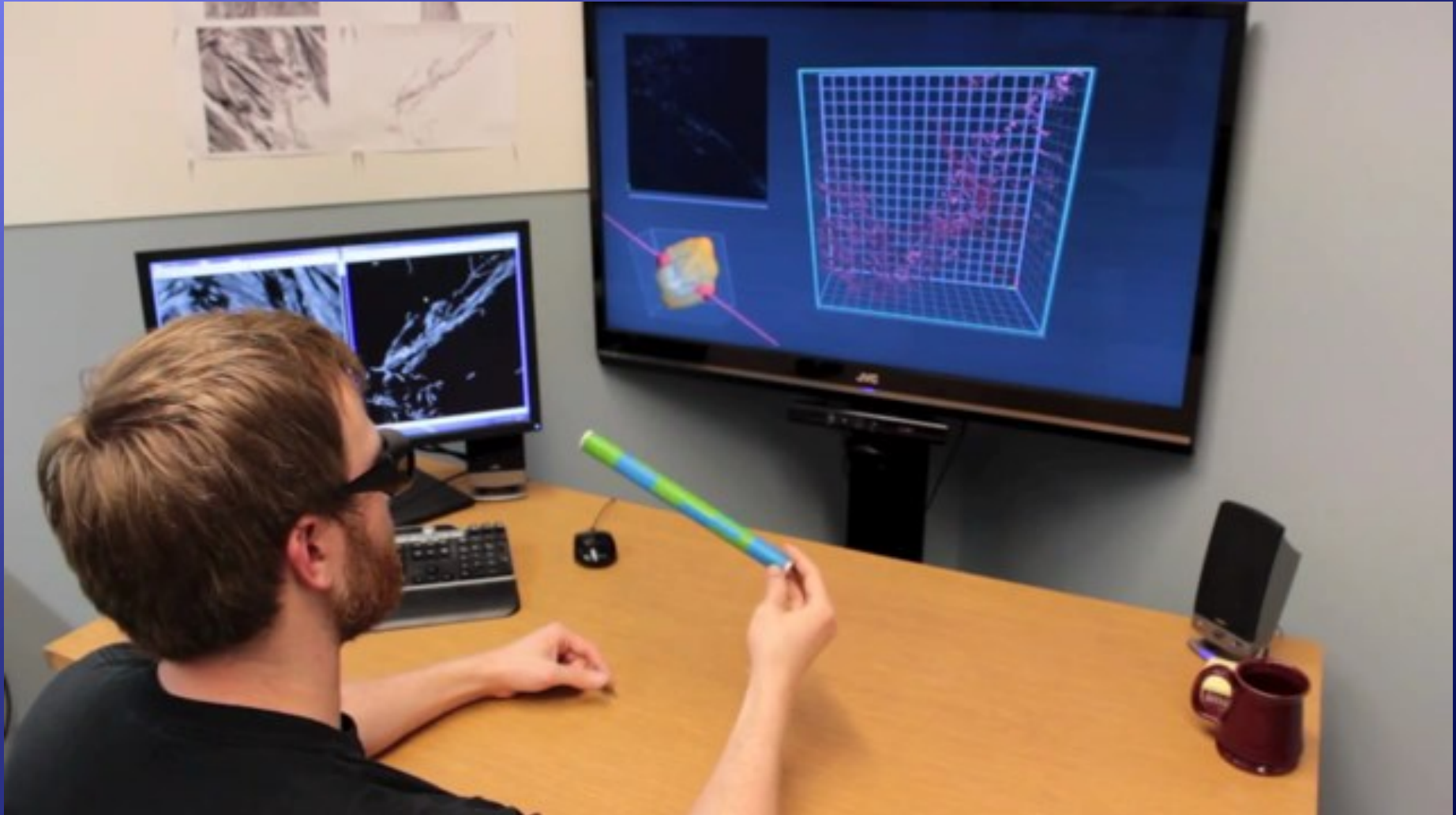National Aeronautics and Space Administration

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Latest 3D and NUI devices

Meta Pro Concept Video

AR for remote task assistance

Tangible 3D interface for interactive visualization of thin fibers structures

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3D printing and augmented reality for drug design

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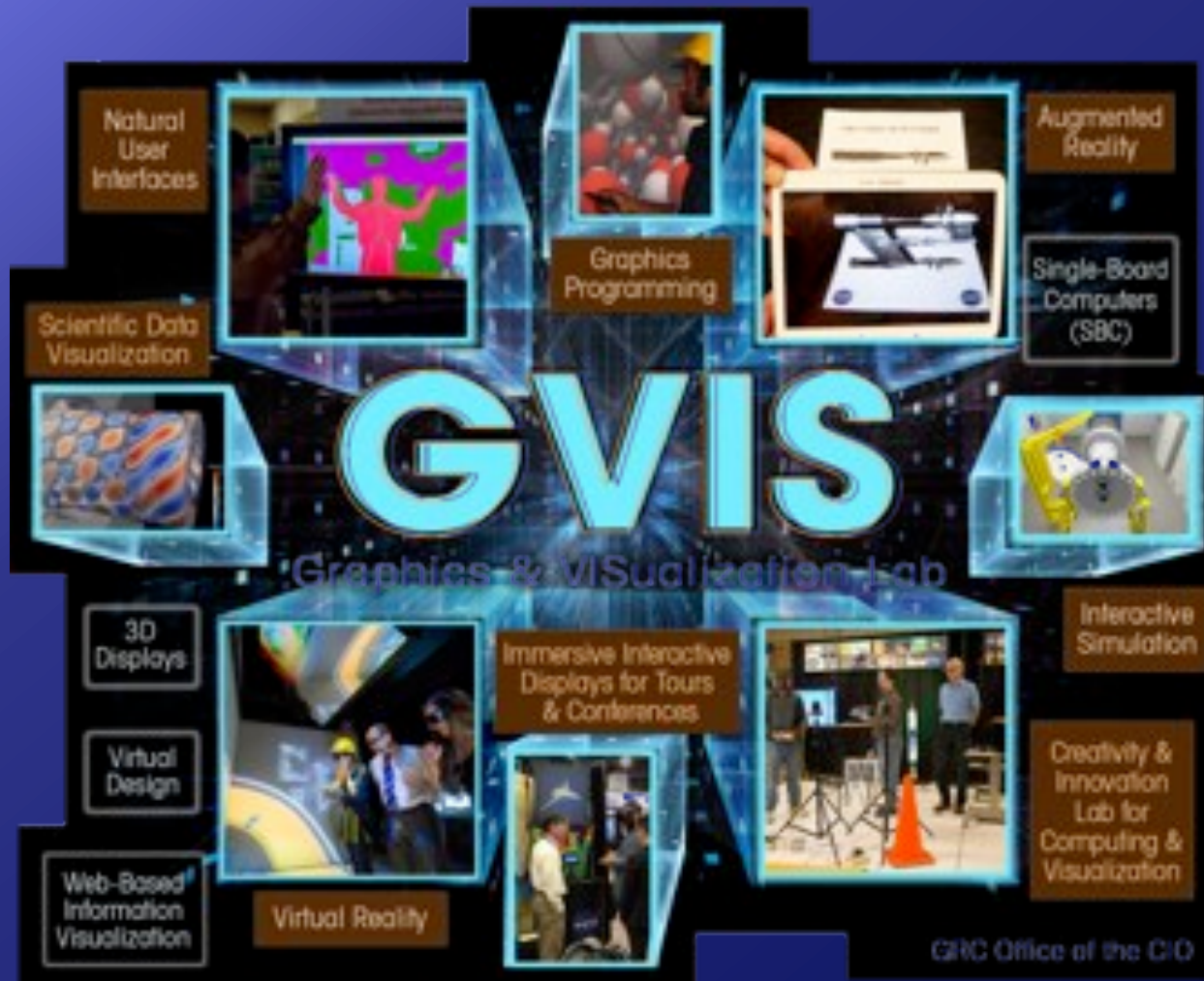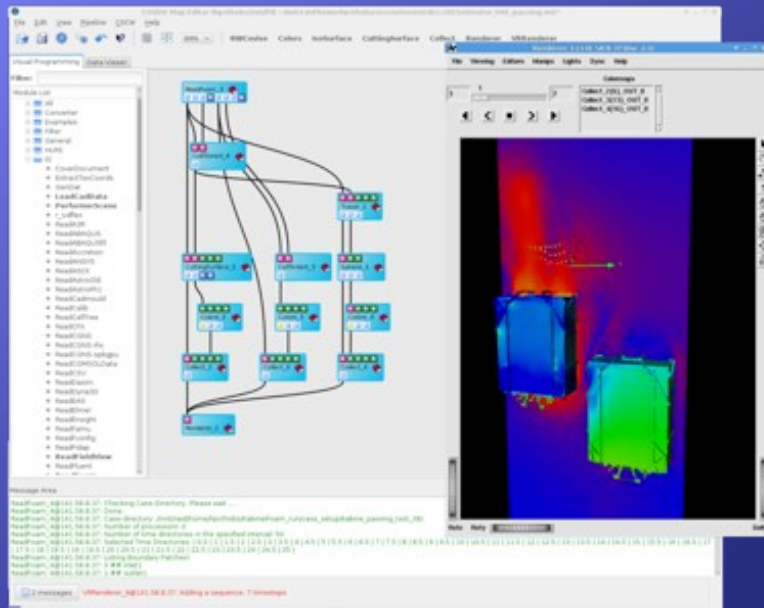
GRUVE Lab
(Glenn Reconfigurable User-interface & Virtual Reality Exploration)

- Four walled CAVE™
- 8 feet by 8 feet
- Head tracking
- 3D mouse
- Only CAVE™ in northern Ohio

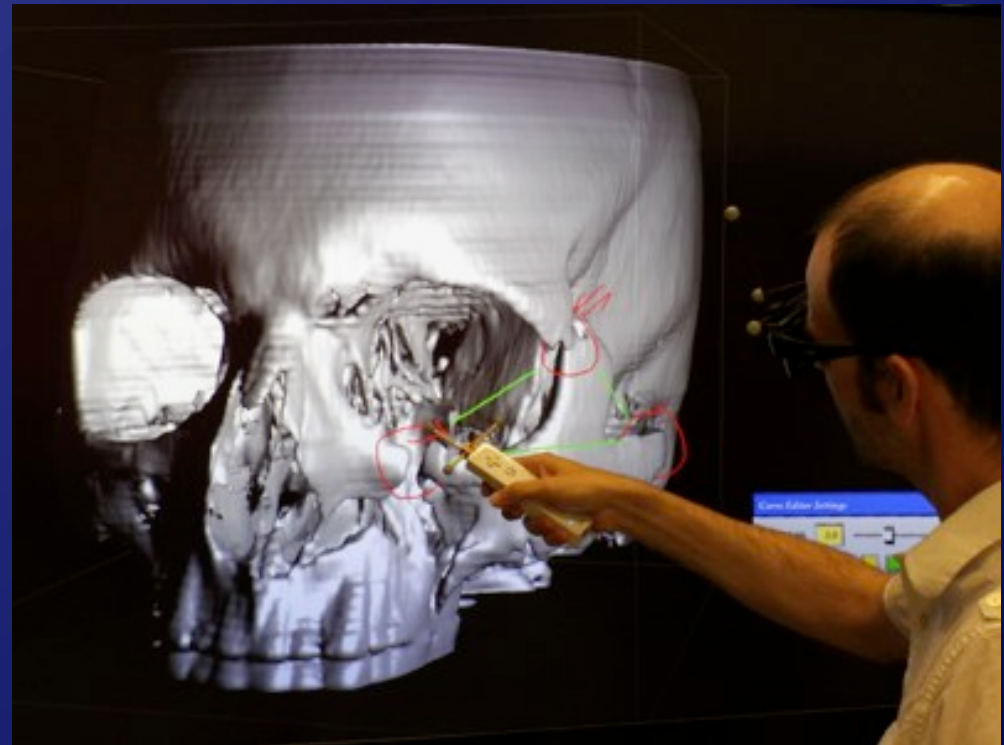# Immersive 3D environments for activating brain mirror neuron networks thru motor imagery training
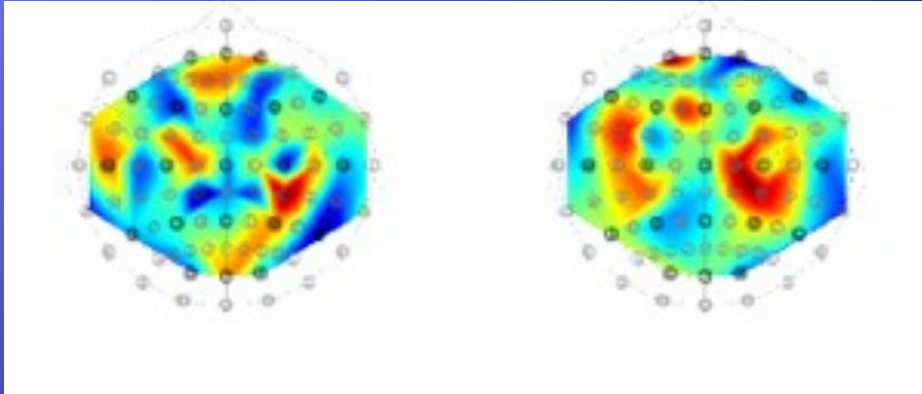
COVISE and VRUI

COVISE dev environment

VRUI-based 3D Visualizer

Visualization of lunar excavation test in GRUVE Lab

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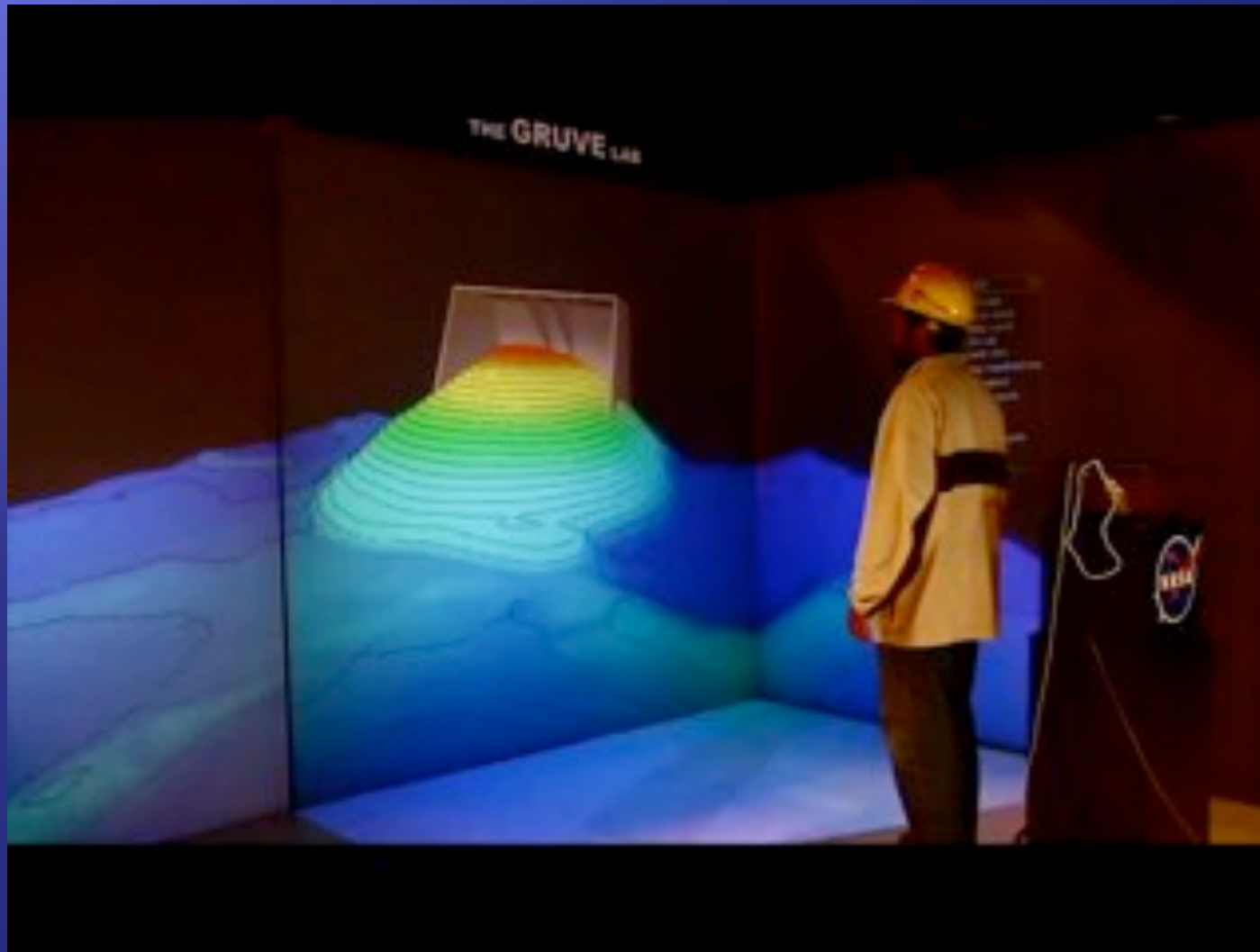
3D scanning and point cloud visualization

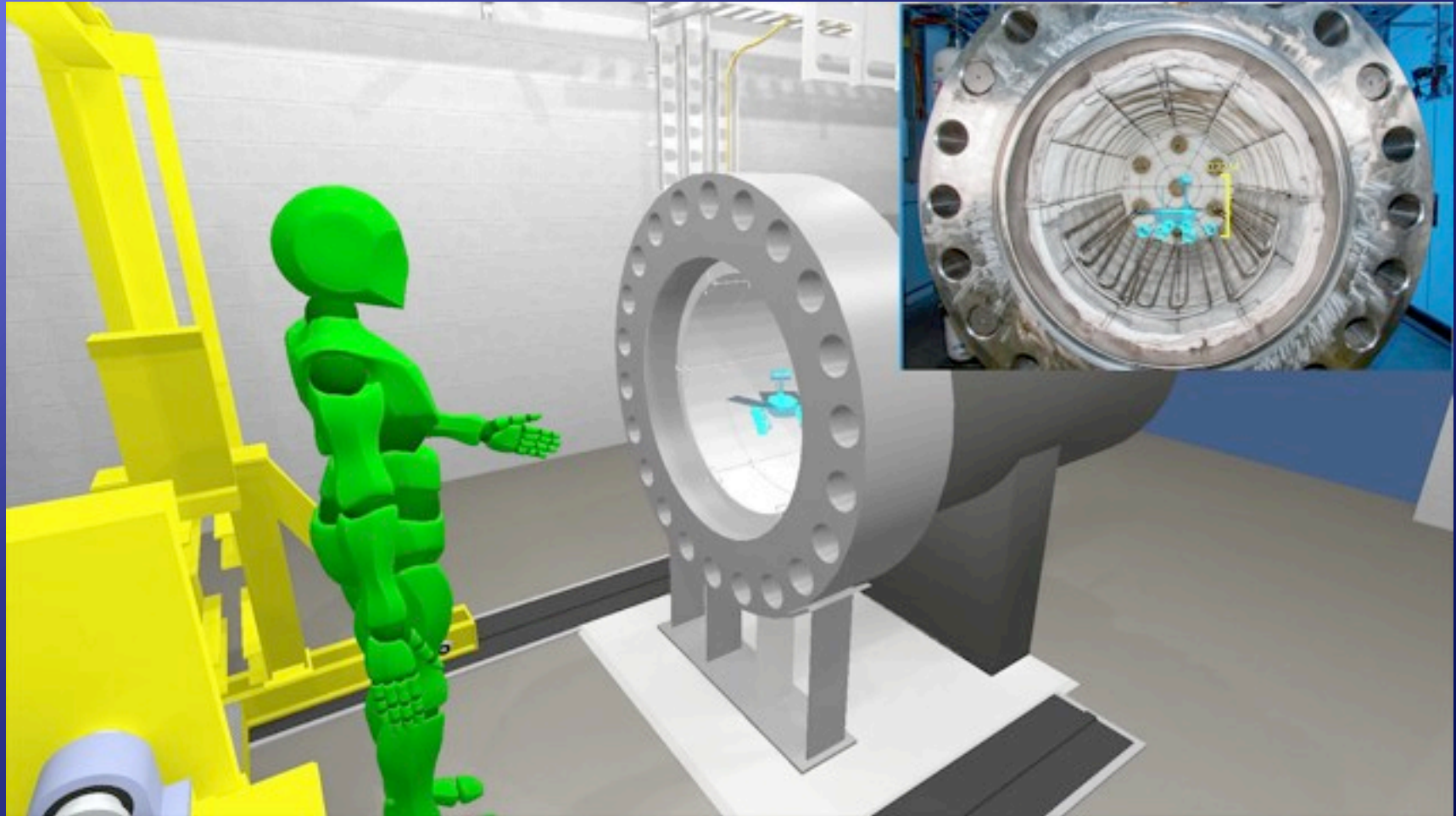Space Shuttle Mission Control
Point Cloud
in GRUVE Lab
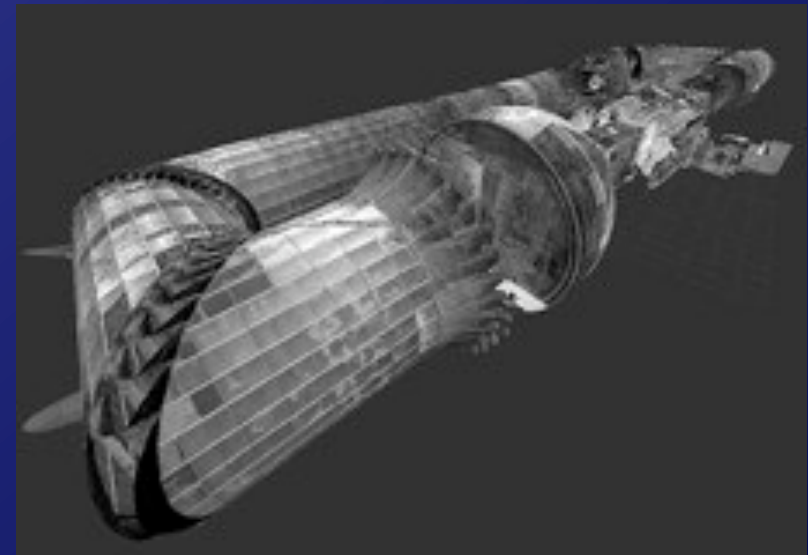
Point Cloud of NASA Langley
Hypersonic Facilities Complex

Virtual Reality – Head Mounted Displays

Work from Anywhere for Lab Researchers

Collaborative Head Mounted CFD Immersive 3D Viewer
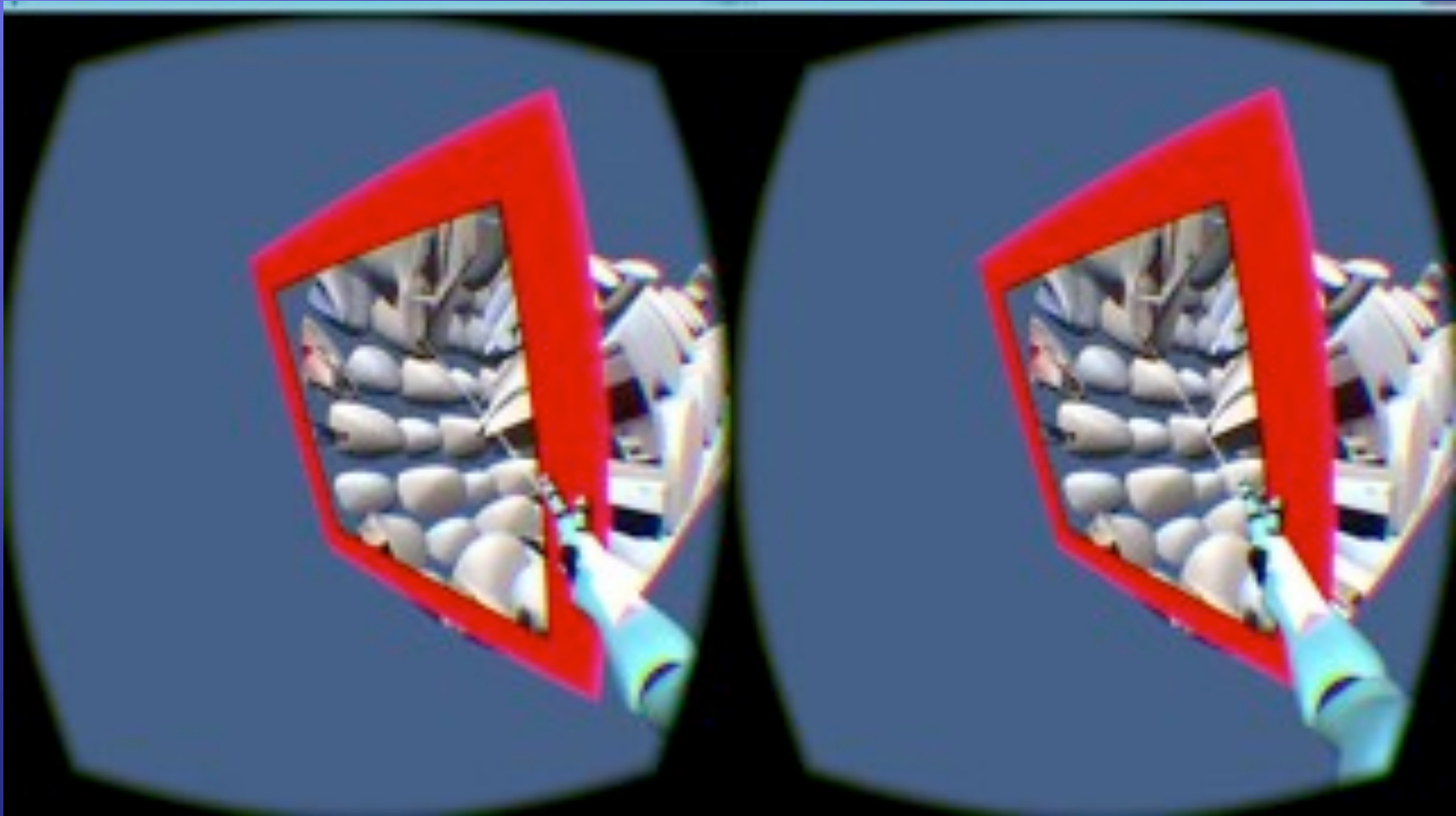
Virtual Reality – simulation of Mars mission

Desired Scan Fidelity: 2cm per px at 50m   1cm per px at 50m   2mm per px at 50m
Required Sensor Resolution: 2,071px X 2,071px   4,142px X 4,142px   20,710px X 20,710px
Camera Angle: 45°   (~4.3MP)   (~17.2MP)   (~428.9MP)

Press B To Hide

25 M   12.5 M   6.25 M   1 M   0 M
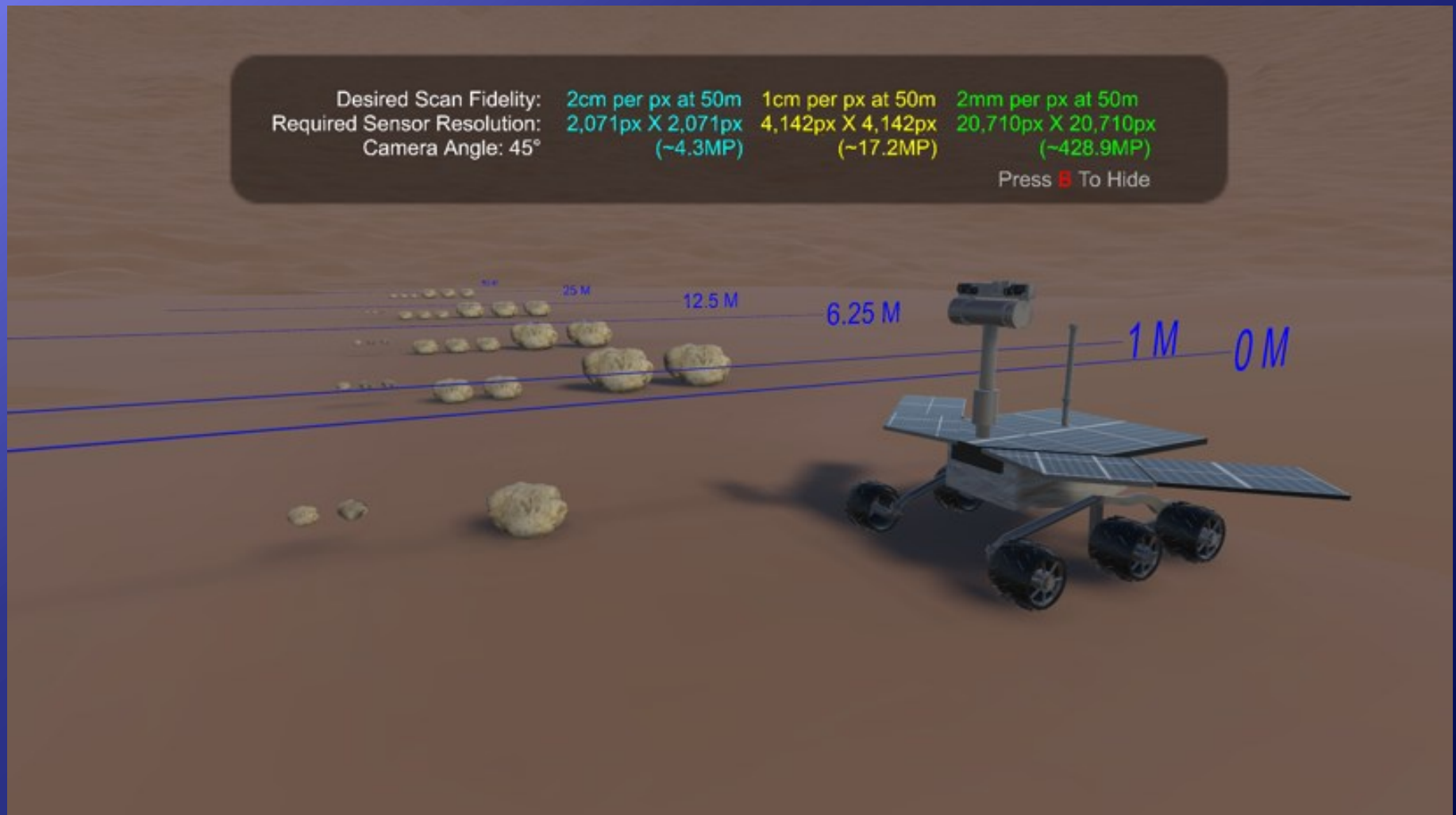
Augmented reality and fluid dynamics
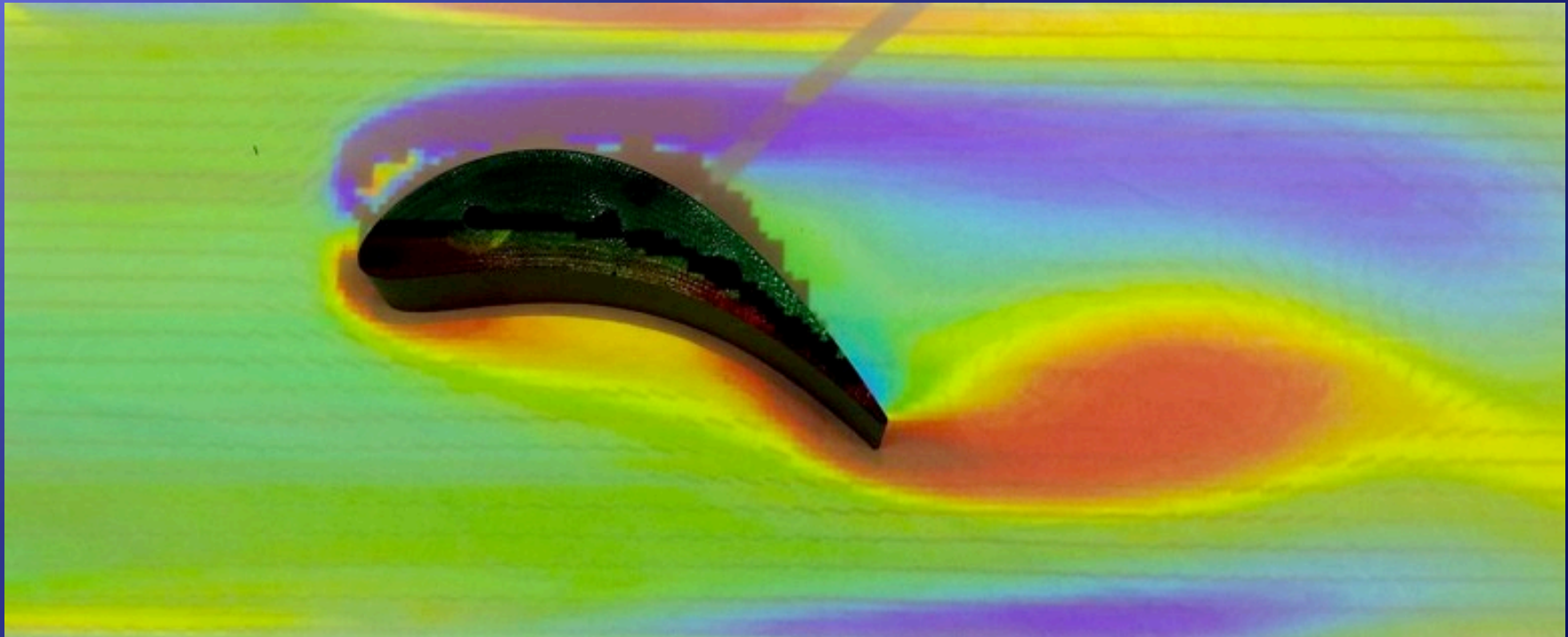
SLOPE Lab's Augmented Reality Sandbox
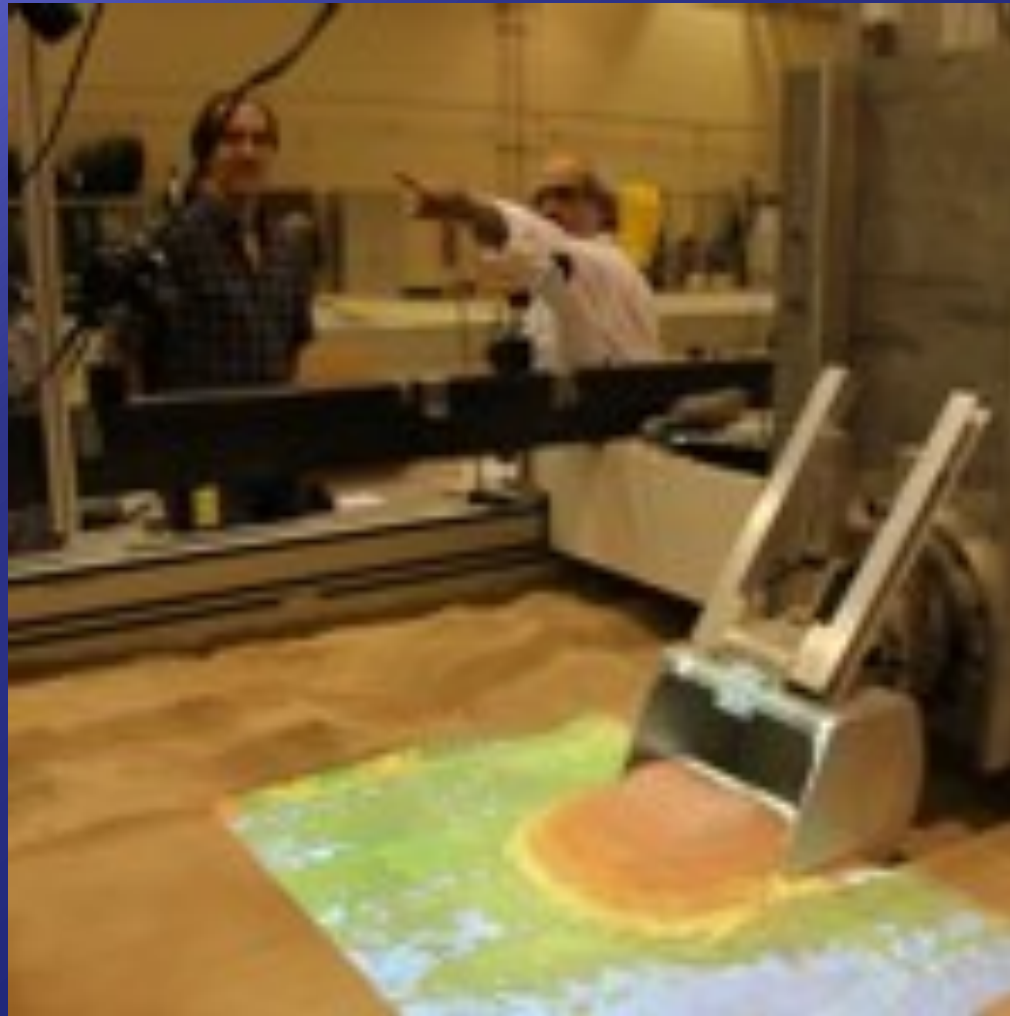
Tablet-based augment reality
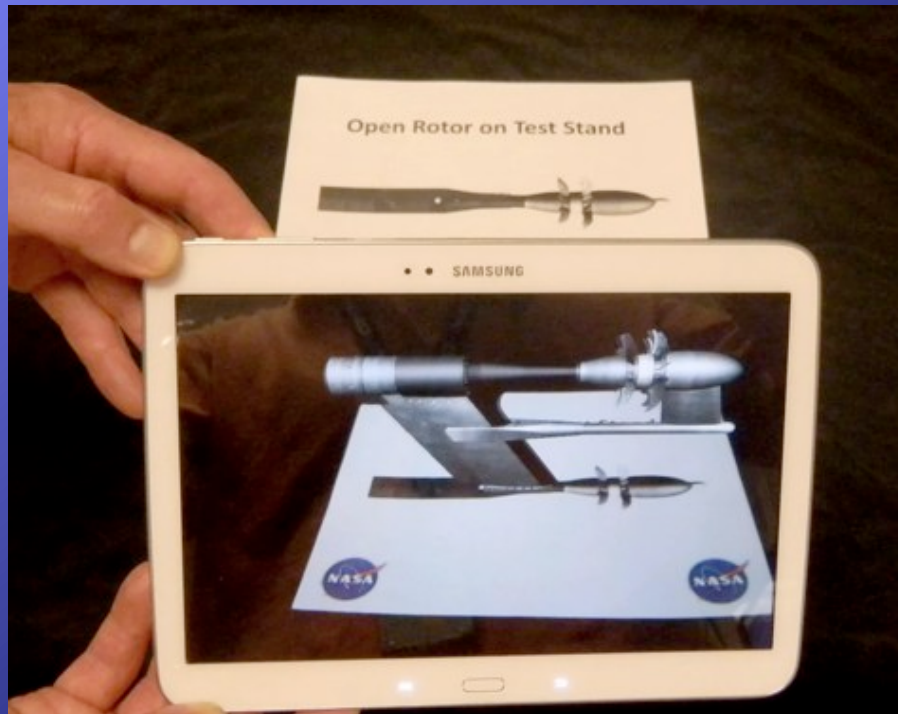
Pepper's Ghost and Leap Motion

NUI for Kennedy Space Center Firing Room

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Visual immersive workspaces for collaboration

Multi-surface, natural user interface displays

http://www.youtube.com/watch?v=fcMhZ9JoqN8

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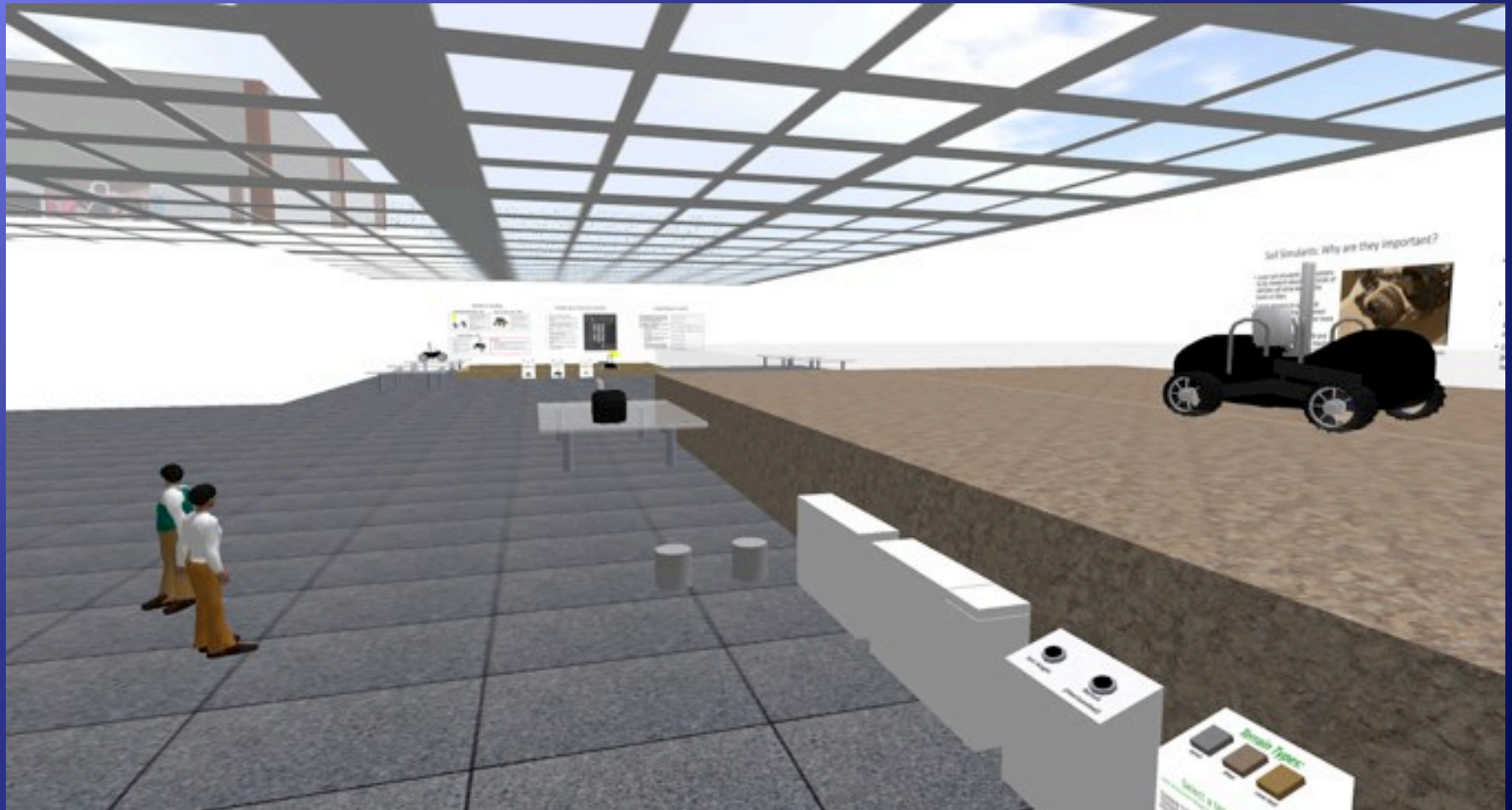
Projection mapping content and control Science on a Sphere

Virtual SLOPE (Simulated Lunar Operations) Lab

Virtual worlds
OpenSim using Oculus and Kinect

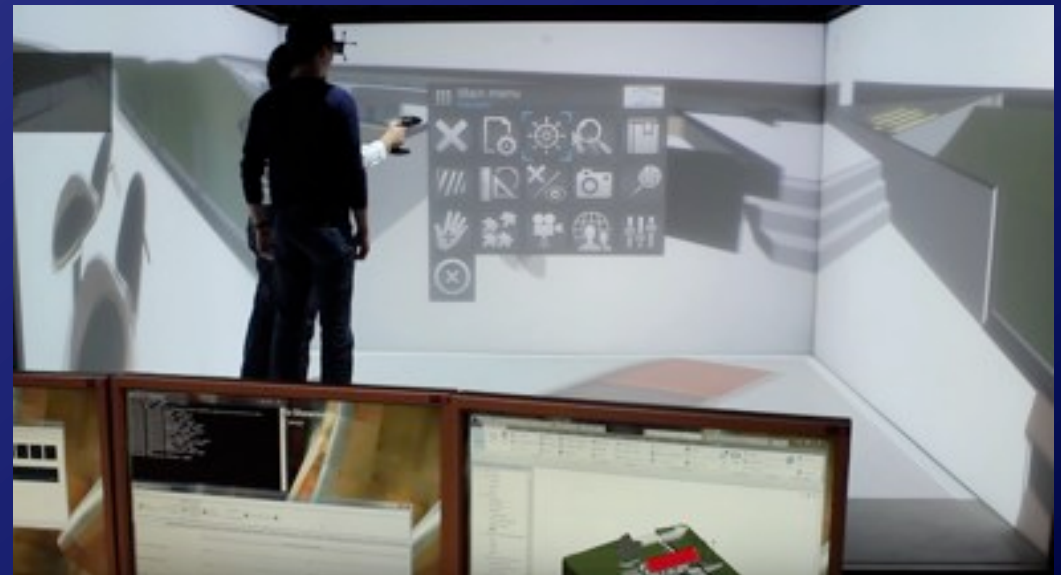# Hathaway Brown School VR project

Virtual Space Laser
Communication Game

Virtual Astronaut Glove Box

AR/VR and BIM (Building Information Modeling)

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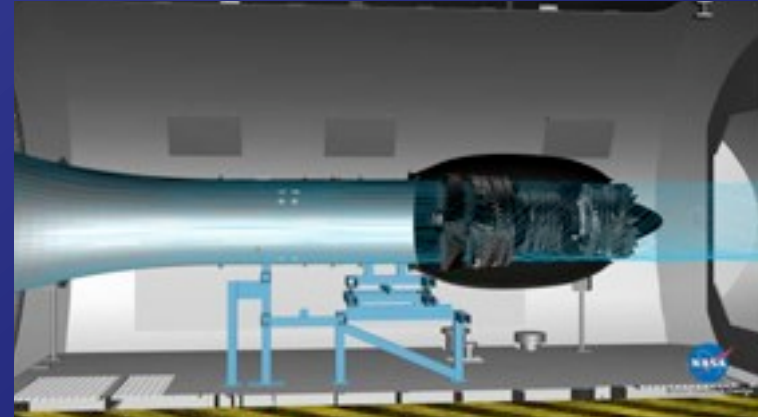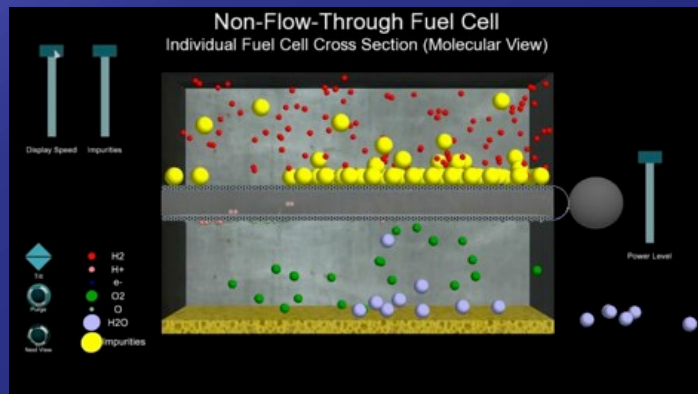
Interactive 3D simulations
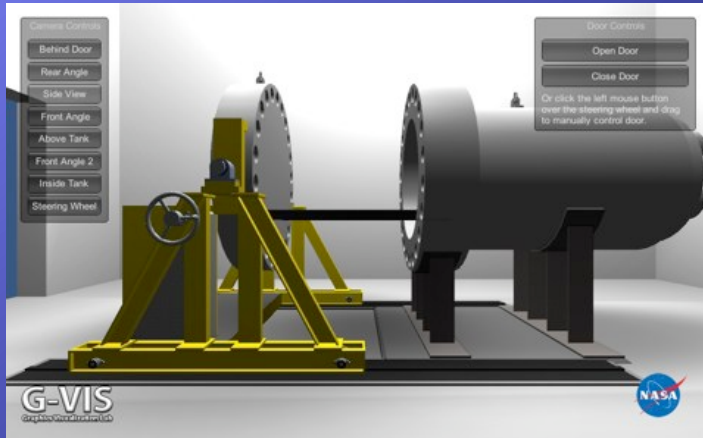
Extreme Environments Test Cell
Visualization

Propulsion Systems Laboratory (PSL)
Visualization

Virtual Fuel Cell
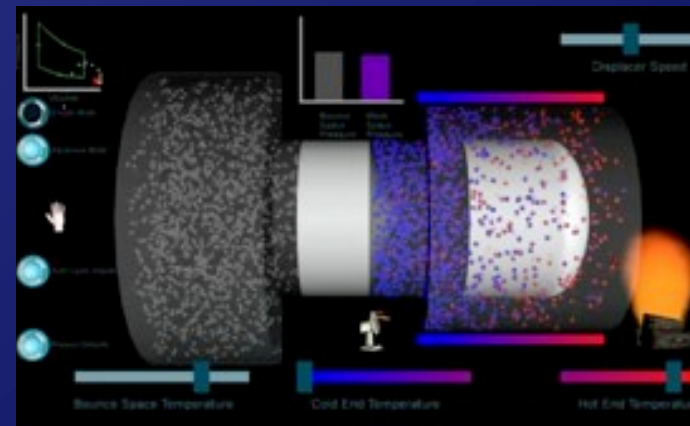
Virtual Stirling Engine

Interactive 3D simulations

Scientific visualization in 3D

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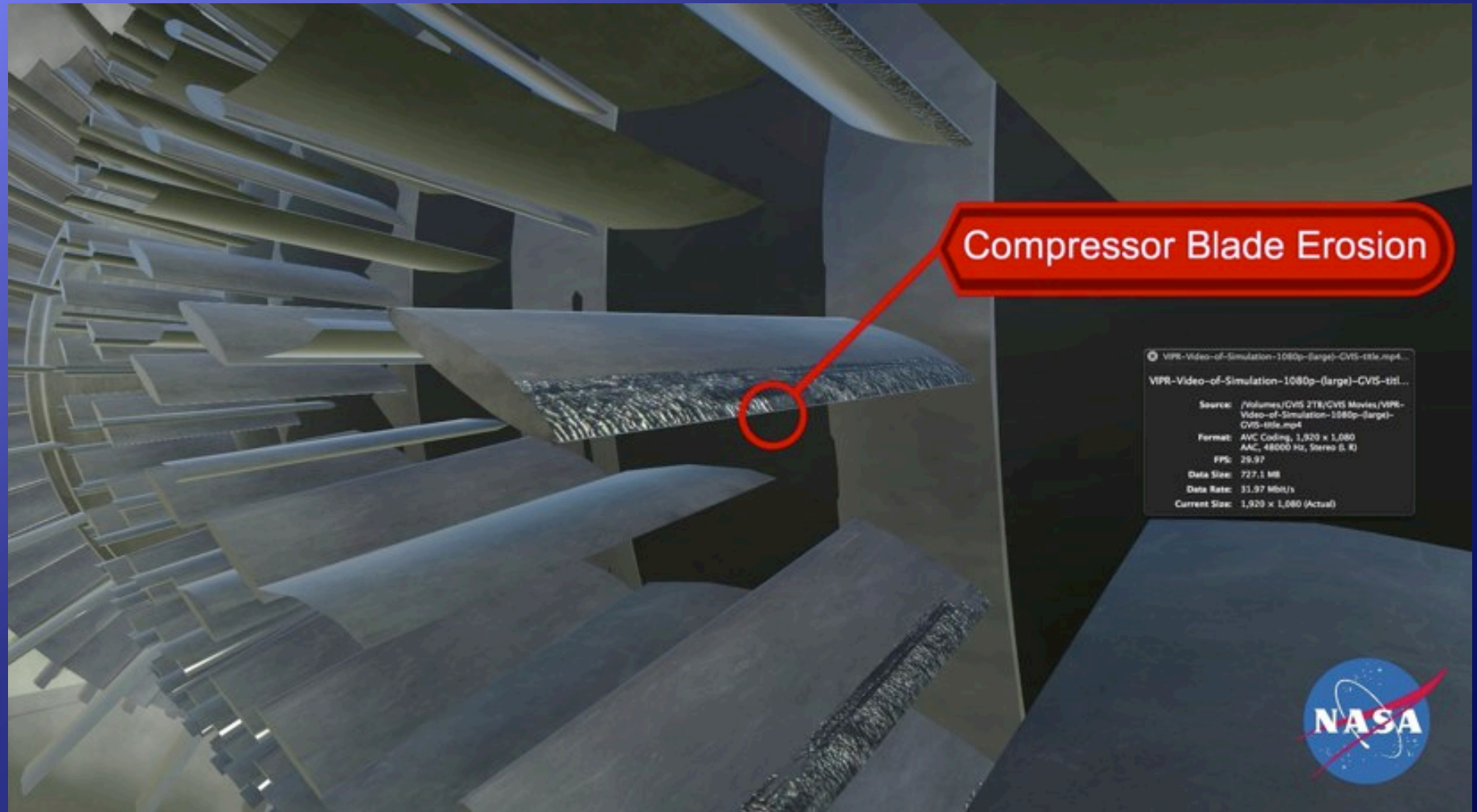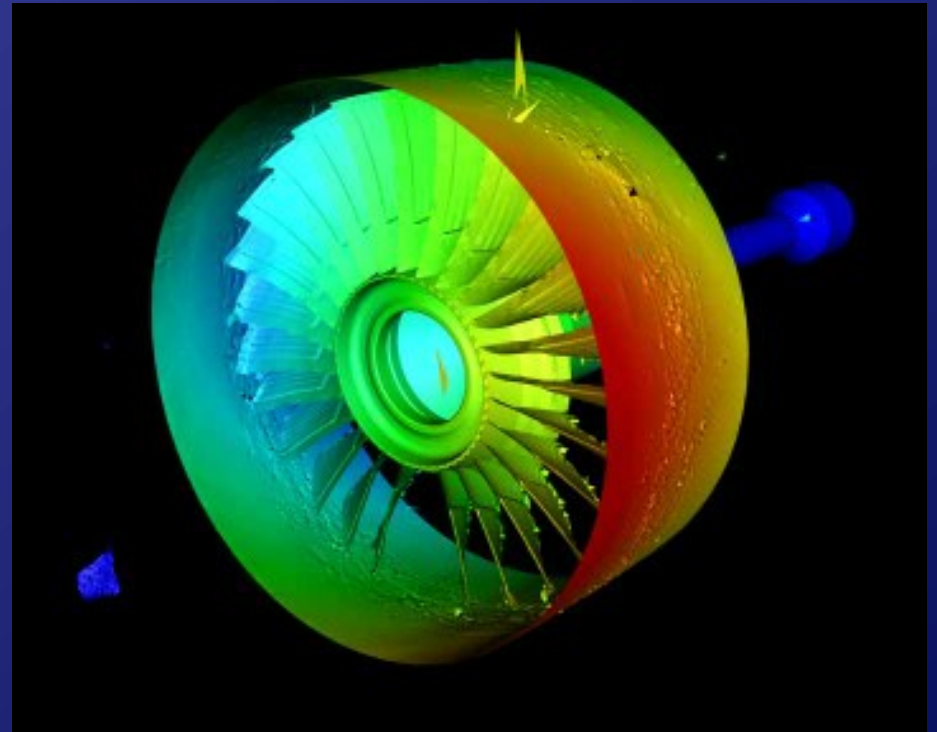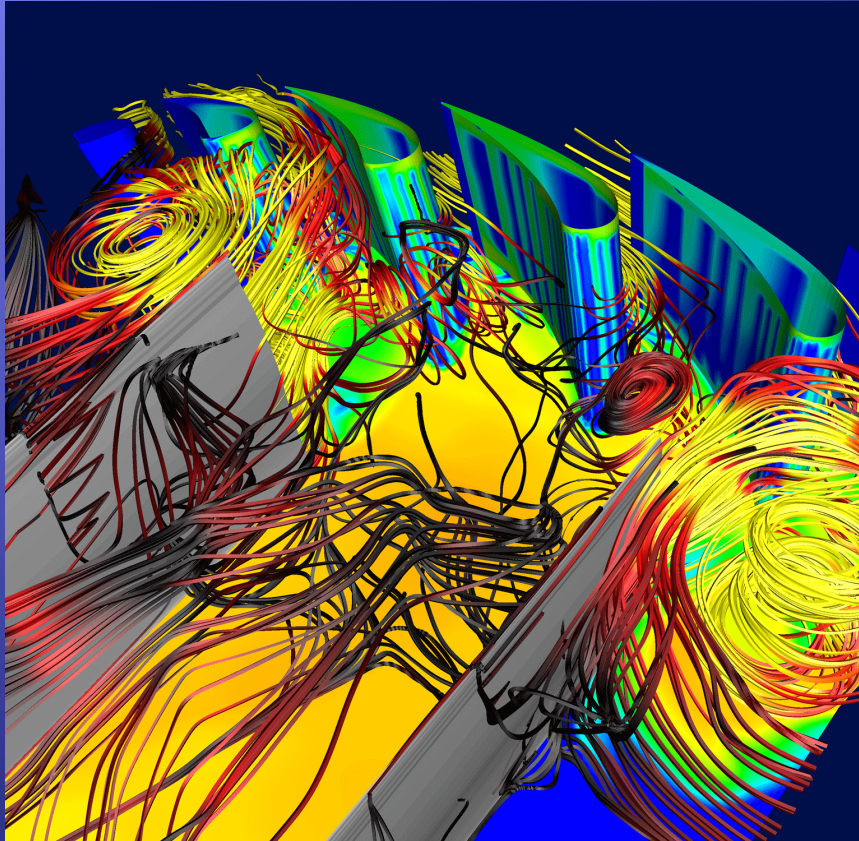
Scientific visualization in 3D
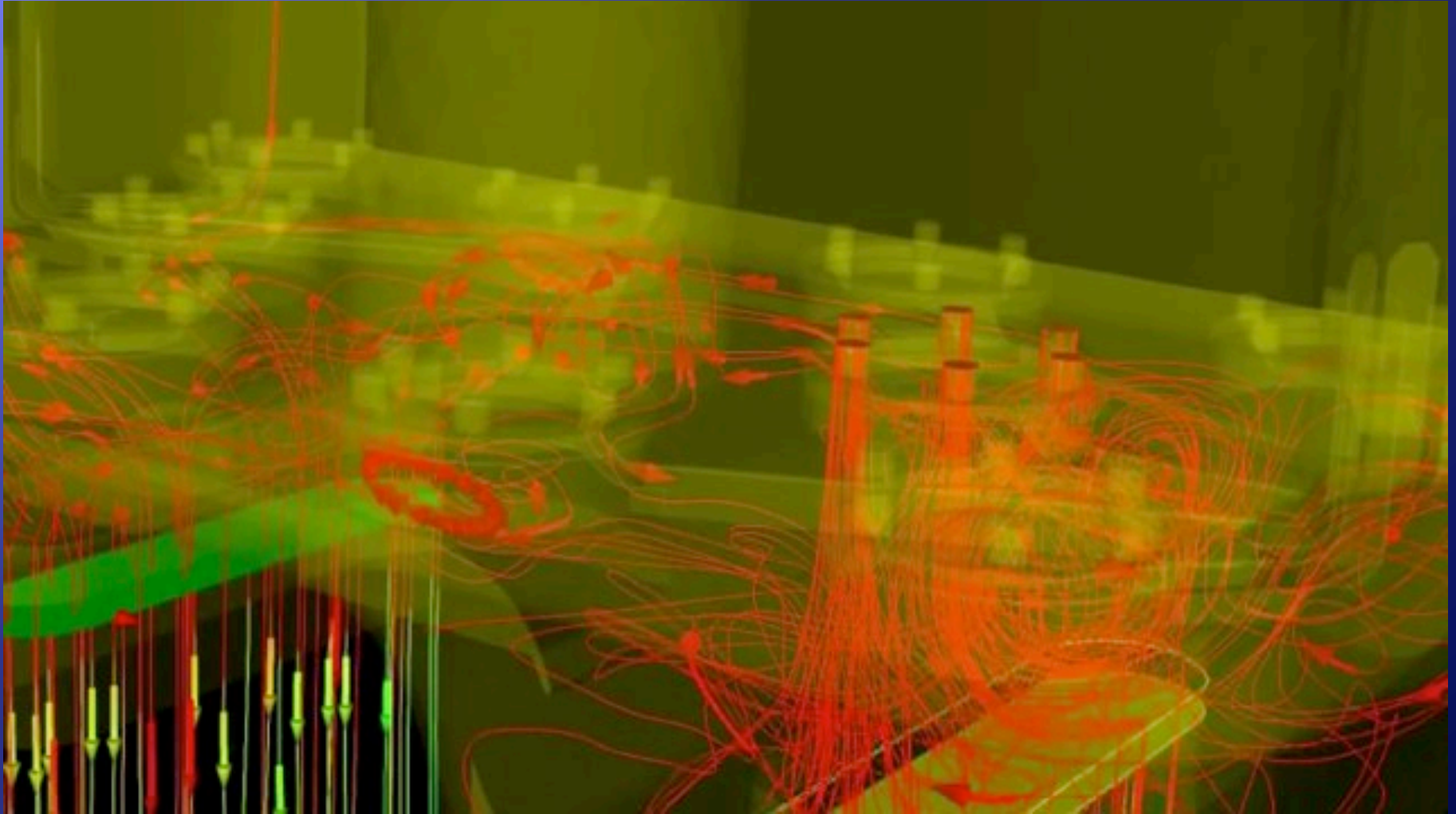
AR, VR and NUI at NASA
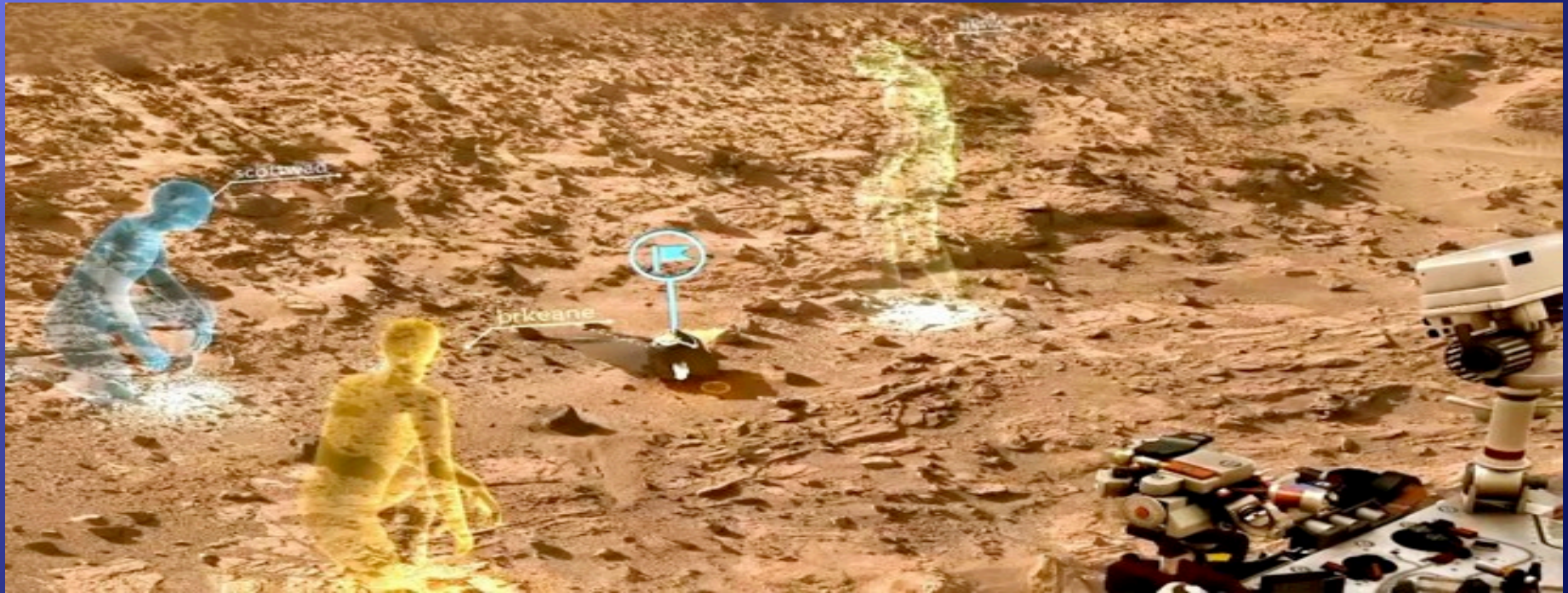
OnSight, a software tool developed by NASA's JPL, uses real rover data to create a 3-D simulation of the Martian environment

AR, VR and NUI at NASA

Space walk hardware review in the VR Lab at Johnson Space Center

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AR, VR and NUI at NASA

Project Sidekick, a virtual reality aid for astronauts based on Microsoft's HoloLens

Rich Rinehart, Paul Catalano, Tad Kollar, Calvin Robinson, Brian Tomko, Brian Sommers, Drayton Munster (on laptop), Herb Schilling, Lauren McIntyre

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Coming attractions

Summer Internships

Undergrads – apply by March 1

Application of Big Data Analytics/Data Mining to Rotorcraft Health Management System

Cost Effective Reality Computing Devices for Air Breathing Propulsion

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2016 International Space Apps Challenge

April 22, 23 and 24

NASA Glenn Open House

May 21 and 22

Saturday Tour of GVIS

August 6

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